CHAPTER

5 Pile Foundations – General

Specifications

The specifications for piling and pile driving are contained in Section 49 of the Standard Specifications. Unusual requirements or options for particular projects are contained in the Special Provisions. The project plans and Standard Plans are additional contract documents needed for pile work. As-Built plans should be obtained for widening and seismic retrofit projects.

The normal format would be to describe the intended pile type, specified tip elevation, and, in the case of driven piles, the minimum bearing value in the project plans or Special Provisions or both. These documents would also include specific requirements for embankment predrilling, load testing and other items peculiar to the project. For example, if driving difficulty is anticipated, the Project Designer may allow substitution of steel "H" piling for precast concrete piles. When this option is written into the contract, other conditional clauses are usually provided (no additional compensation for piling driven below specified tip, etc.). If the specification allowing the option is not included in the contract, changes from one pile type to another cannot be made without the benefit of a change order.

Structure details for the piles are found in the Standard Plans. The Standard Plans also provide alternative details for certain pile types. This is not to be confused with the option to substitute or change pile type as mentioned in the previous paragraph. If, for example, Class 70C concrete piles are specified, they can be either of the alternatives shown in the Standard Plans for Class 70C concrete piles. However, the alternatives that may be used do not include the alternatives shown in the Standard Plans for Class 70 concrete piles. Occasionally, the Project Designer may decide not to allow all of the alternatives for a given pile type. In this situation, the alternatives to be excluded would be noted in the Special Provisions or project plans.

The Standard Specifications contain the general information for pile work. This includes specifics for types of materials to be used, methods of construction, measurement, payment, etc. It is important to remember that the Special Provisions and the contract plans have precedence over the Standard Plans and Standard Specifications. For this reason, it is imperative that all contract documents be thoroughly reviewed well in advance of the work.

Non-Driven Piles

Cast-In-Drilled-Hole (CIDH) piles consist of concrete cast in holes drilled in the ground to a specified tip elevation. Diameters range from 12 to 126 inches and lengths range from 10 feet to over 120 feet. They are satisfactory in suitable material and are generally more economical than most other types of piling. They are especially advantageous where vibration from a pile driver might damage adjacent structures such as pipelines, etc. For obvious reasons the ground formations into which the holes are drilled should be capable of retaining their shape during drilling and concrete placing operations and no ground water should be present. If ground water is present, the slurry displacement method specifications may need to be incorporated into the contract. CIDH piles are discussed in more detail in Chapters 6 and 9 of this manual.

Driven Piles

Driven piles typically consist of three different types: (1) concrete, (2) steel, and (3) timber. A general description of each type is given on the following page. Driven piles are discussed in more detail in Chapter 7 of this manual.

TYPE OF PILE	DESCRIPTION
Driven Piles – Concrete	Driven concrete piles come in a variety of sizes, shapes and methods of construction. In cross section, they can be square, octagonal, round, solid or hollow. These piles generally vary in sizes from 10 to 60 inches. They can be either conventionally reinforced or prestressed (most common). They can also be either precast (most common) or they can be cast in driven steel shells. The types of steel shells vary from 10 to 18 inches in diameter for heavy walled pipe which are driven directly with the hammer, to thin walled or step-taper pipes which are driven with a mandrel. The steel shell may have a flat bottom or be pointed, and may be step-tapered or a uniform section. Caltrans has standard details for splicing precast concrete piles but it is a difficult, time consuming, expensive procedure. Hence, this almost precludes the use of precast piles where excessively long piles are required to obtain necessary bearing. The unit cost to furnish concrete piles is usually lower than the steel equivalent. But this cost is often offset by the requirement for a larger crane and hammer to handle the heavier pile. This is particularly true when there are a small number of piles to drive.
Driven Piles – Steel	Steel piling includes "H" piles and pipe piles (empty or concrete filled). The pipe section is a standard alternate for the Class 45 and 70 piling, but is seldom used. Although steel piling is relatively expensive on a per foot furnish basis, it has a number of advantages. They come in sizes varying from HP 8×36 to HP 14×117 rolled shapes or may consist of structural steel plates welded together. They are available in high strength and corrosion-resistant steels. They can penetrate to bedrock where other piles would be destroyed by driving. However, even with "H" piles, care must be taken when long duration hard driving is encountered as the pile tips can be damaged or the intended penetration path of the pile can be drastically deflected. Some of this type of damage can be prevented by using a reinforced point on the pile. Due to the light weight and ease of splicing, they are useful where great depths of unstable material must be penetrated before reaching the desired load carrying stratum and in locations where reduced clearances require use of short sections. They are useful where piles must be closely spaced to carry a heavy load because they displace a minimal amount of material when driven. Splice details are shown on the Standard Plans or project plans for contracts that permit the use of steel piling. Pile welding work requires special attention and various methods can be used to prequalify welders who will be doing the work. Sometimes "H" piles must be driven below the specified tip elevation before minimum bearing is attained. This can present an administrative problem (cost) if the length driven below the specified tip elevation is significant. Steel lugs welded to the piles are commonly used to solve this problem. This subject is covered in detail in Bridge Construction Memo 130-5.0.
Driven Piles – Wood	Untreated timber piles may be used for temporary construction, revetments, fenders and similar work; and in permanent construction where the cutoff elevation of the pile is below the permanent ground water table and where the piles are not exposed to marine borers. They are also sometimes used for trestle construction, although treated piles are preferred. Timber piles are difficult to extend, hard to anchor into the footing to resist uplift, and subject to damage if not driven carefully. Timber piles also have a maximum allowable bearing capacity of 45 Tons, whereas most structure piles are designed for at least 70 Tons.

Alternative Piles

Currently there are several new alternative pile types which are being reviewed and tested by the Office of Structure Construction and the Office of Structural Foundations. These are designed and used on a site-specific basis. The three types now being reviewed and tested are the GeoJet Foundation Unit, the Tubex Grout Injection Unit, and the Nicholson Pin Pile. The GeoJet Foundation Unit consists of a structural member inserted into an augured soil-cement column. The Tubex Grout Injection Unit is a steel pipe pile with a special cast-iron tip filled with concrete surrounded by an injected grout/soil mixture layer. The Nicholson Pin Pile is a bored cast-in-place pile with a reinforcing bar in a grouted hole.

Refer to Appendix D for drawings and schematics of the various alternative piles.